

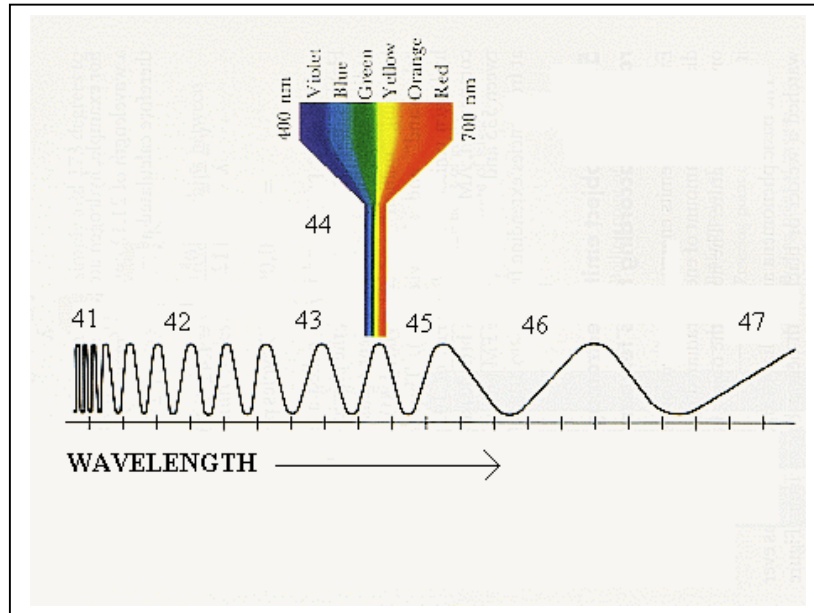
#### Activity #4: Introduction to the Electromagnetic Spectrum –Student’s Copy-ANSWER SHEET

URL: [http://imagine.gsfc.nasa.gov/docs/science/know\\_11/emspectrum.html](http://imagine.gsfc.nasa.gov/docs/science/know_11/emspectrum.html)

**Make no marks on this paper. Place all responses on the answer sheet provided.**

1. What is the name given to a bunch of types of radiation when scientists want to talk about them as a group? **electromagnetic spectrum or EM**
2. What do we call energy that travels and spreads out as it goes? **radiation**
3. Are aircraft and shipping radio band wavelengths longer or shorter than the waves you receive on your radio when you tune into 107.3 on your FM dial? **longer**
4. Name something else besides a radio station that can emit radio waves. **stars and gases in space**
5. What can these radio waves tell you about the object that emits them? **of what they are made**
6. Besides cooking their popcorn in 3 minutes and 20 seconds, for what do astronomers use microwaves? **to learn about nearby galaxies**
7. What type of radiation is used to map the dust between stars in space? **Infrared (IR)**
8. What substances in the universe emit X-rays? **hot gases**
9. True or false: The light emitted by fireflies is considered visible radiation. **true**
- 10.–12. Name three things that can produce gamma rays. **naturally radioactive materials, nuclear power plants, big particle accelerators, or the universe**
13. Are gamma rays and radio waves really different things? **No, they are fundamentally the same.**
14. What is the mass of the particles that form the stream of electromagnetic radiation? **Zero—they are massless.**
15. In what type of pattern do these particles travel? **a wavelike pattern**
16. What is the speed of these particles? **speed of light (182,282 miles/sec or 300,000 km/sec)**
17. What is the bundle of energy called that is contained in these particles? **photon**
18. What is the difference between the various types of electromagnetic radiation? **the amount of energy found in the photons.**
19. True or false: Because microwaves can actually be used to cook your food, they contain lots of energy. **False—only a little more energy than radio waves**
20. What are the most energetic waves of all? **gamma rays**
- 21 – 23. Name three terms that can be used to describe the electromagnetic spectrum? **energy, wavelength and frequency**
24. In what units is frequency is measured? **cycles per second**
25. Give a one-word term for your answer to # 24. **hertz (Hz)**
26. What units are used to measure wavelength? **meters (or angstroms or nanometers)**
27. Electron-volts measure what? **energy**
28. True or False: Scientists LOVE to use big numbers---even when they don’t have to. **false**
29. The radio portion of the EM spectrum contains waves of what lengths? (Give a range.) **1 cm to 1 km**
30. What is the frequency range of these radio waves? **1 kHz to 1 MHz**
31. What is the term for a millionth of a meter? **micron**
32. Which is larger: an angstrom or a nanometer? **A nanometer is 10 times larger than an angstrom (10<sup>-9</sup> meters vs. 10<sup>-10</sup> meters.)**
33. Name the colors that fall between 400 and 700 nanometers in wavelength. **violet, blue, green, orange, yellow, red**
34. In what units do scientists refer to the energies of the photons in the UV to gamma-ray region of the EM spectrum? **electron volts**
35. True or False: Gamma-rays have energies greater than 100 thousand electron volts? **True-100 keV**
- 36-37. Name two types of radiation that can reach the earth from space. **visible spectrum and radio frequencies**

38. What types of radiation can be observed from mountaintops or from telescopes in airplanes? **some infrared**
39. Balloons with instrumentation aboard can reach what altitudes? **35 km**
40. What is the best vehicle for long-term observations of EM radiation from space? **an orbiting satellite**
- 41-47. Clicking on the link “Show me a chart of the wavelength, frequency and energy regimes of the spectrum!” label the type of radiation (i.e., radio gamma, etc.) of the electromagnetic spectrum that matches the corresponding wavelength in the diagram below.



41. **gamma ray**
42. **X-ray**
43. **ultraviolet**
44. **visible light (optical)**
45. **infrared**
46. **microwave**
47. **radio**